

**PART I**  
**Total Value: 50%**

**Answer all items. Shade the letter of the correct answer on the computer scorable answer sheet. All items in Part I have a value of one point.**

1. What equation is produced if  $y = x^2$  is translated 4 units down, 3 units right, and vertically stretched by a factor of 10?

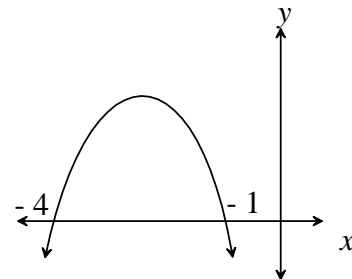
- (A)  $\frac{1}{10}(y-4) = (x+3)^2$
- (B)  $\frac{1}{10}(y+4) = (x-3)^2$
- (C)  $10(y-4) = (x+3)^2$
- (D)  $10(y+4) = (x-3)^2$

2. What is the range of  $-\frac{1}{4}(y-2) = (x-3)^2$ ?

- (A)  $\{y \mid y \leq 2, y \in \mathbf{R}\}$
- (B)  $\{y \mid y \geq 2, y \in \mathbf{R}\}$
- (C)  $\{y \mid y \geq 3, y \in \mathbf{R}\}$
- (D)  $\{y \mid y \in \mathbf{R}\}$

3. The graph of a quadratic function  $f(x)$  is shown. Which is a possible value for the discriminant of  $f(x) = 0$ ?

- (A) -4
- (B) -1
- (C) 0
- (D) 4



4. Which has the smallest vertical stretch factor compared to  $y = x^2$ ?

- (A)  $-\frac{5}{2}(y-1) = (x+1)^2$
- (B)  $-\frac{2}{3}(y-1) = (x+1)^2$
- (C)  $2(y-1) = (x+1)^2$
- (D)  $3(y-1) = (x+1)^2$

5. Which function has a maximum value of 1?

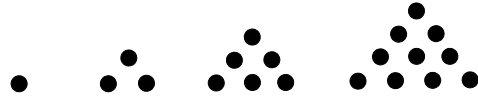
- (A)  $-(y-1) = x^2$
- (B)  $-y = (x-1)^2$
- (C)  $(y-1) = x^2$
- (D)  $y = (x-1)^2$

6. Which has a graph with equal and real  $x$ -intercepts?

- (A)  $-(y-3) = x^2$
- (B)  $-\frac{1}{2}(y+4) = (x+3)^2$
- (C)  $\frac{1}{2}(y-1) = (x+1)^2$
- (D)  $2y = (x-3)^2$

7. What type of sequence is generated by the pattern shown?

- (A) arithmetic
- (B) cubic
- (C) geometric
- (D) quadratic



8. What is the standard form of  $y = \frac{1}{2}x^2 - 8x + 5$ ?

- (A)  $y = \frac{1}{2}(x - 2)^2 + 1$
- (B)  $y = \frac{1}{2}(x - 3)^2 + 3$
- (C)  $y = \frac{1}{2}(x - 8)^2 - 57$
- (D)  $y = \frac{1}{2}(x - 8)^2 - 27$

9. What are all possible values of 'b' that would make  $x^2 + bx + \frac{144}{49}$  a perfect square?

- (A)  $\pm \frac{6}{7}$
- (B)  $\pm \frac{12}{7}$
- (C)  $\pm \frac{24}{7}$
- (D)  $\pm \frac{72}{49}$

10. What are the roots of  $6x^2 - 6x = 5 + x$ ?

- (A)  $\frac{7 \pm i\sqrt{71}}{12}$
- (B)  $-1, \frac{10}{3}$
- (C)  $\frac{5 \pm i\sqrt{145}}{12}$
- (D)  $-\frac{1}{2}, \frac{5}{3}$

11. Which represents a quadratic relationship?

- (A) 

$x$	1	2	3	4	5
$y$	13	21	29	37	45
- (B) 

$x$	2	3	4	5	6
$y$	4	6	12	22	36
- (C) 

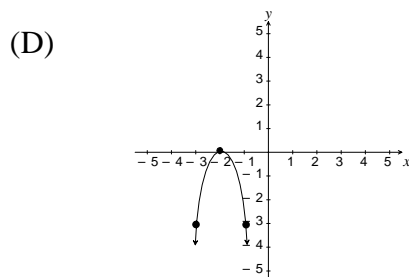
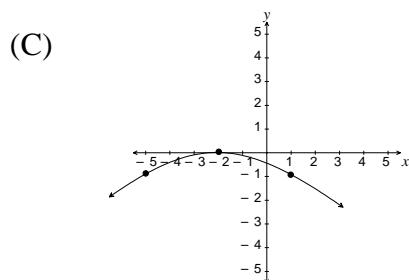
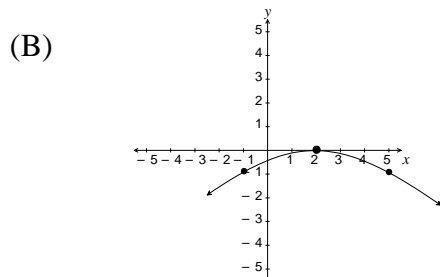
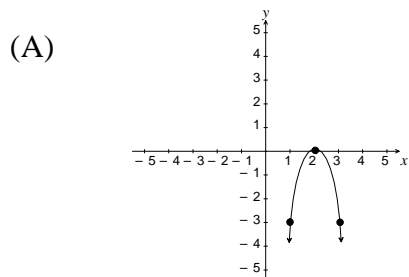
$x$	1	2	3	4	5
$y$	5	10	20	40	80
- (D) 

$x$	2	4	6	8	10
$y$	8	64	216	512	1000

12. Which quadratic equation has roots  $4 + 3\sqrt{2}$  and  $4 - 3\sqrt{2}$  ?

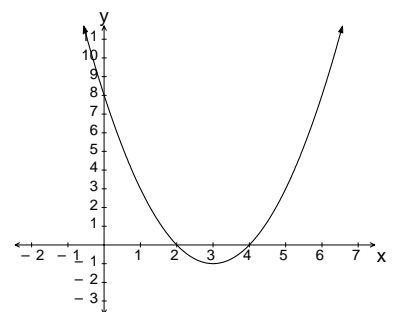
- (A)  $0 = x^2 - 8x - 2$
- (B)  $0 = x^2 + 8x - 2$
- (C)  $0 = x^2 - 8x + 34$
- (D)  $0 = x^2 + 8x - 34$

13. The graph of  $y = x^2$  is transformed using  $(x, y) \rightarrow (x + 2, -3y)$ . Which graph would result?



14. What is the quadratic function for the graph shown?

- (A)  $-(y - 1) = (x + 3)^2$
- (B)  $-(y + 1) = (x - 3)^2$
- (C)  $(y - 1) = (x + 3)^2$
- (D)  $(y + 1) = (x - 3)^2$



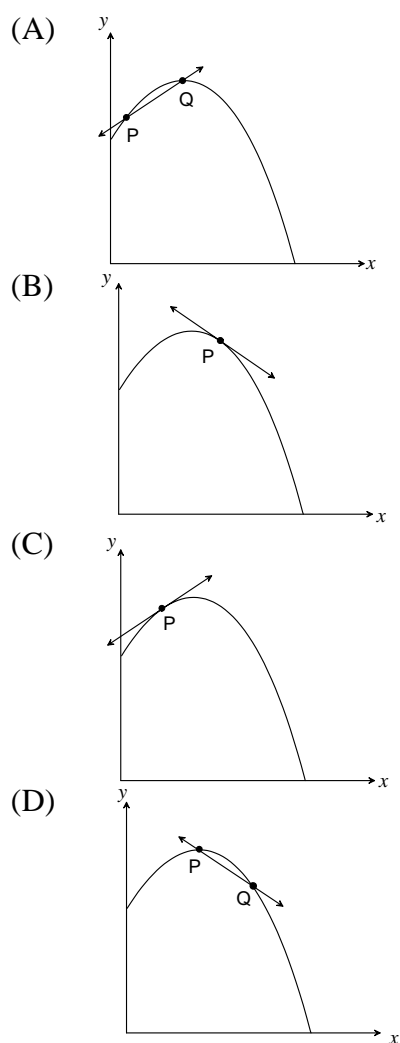
15. What are the zeros of  $y = \sqrt{2}x^2 + 3\sqrt{2}$ ?

- (A)  $\pm\sqrt{3}$
- (B)  $\pm i\sqrt{3}$
- (C)  $i\sqrt{3}$
- (D)  $\pm i\sqrt{6}$

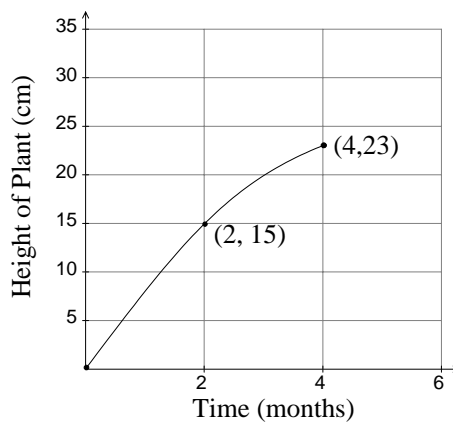
16. What is the value of 'a' if  $0 = ax^2 - 5x + 2$  has discriminant of 3?

- (A)  $-\frac{7}{2}$
- (B)  $-\frac{11}{4}$
- (C)  $\frac{11}{4}$
- (D)  $\frac{7}{2}$

17. Which line best illustrates a negative instantaneous rate of change at P?



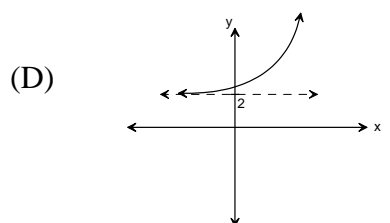
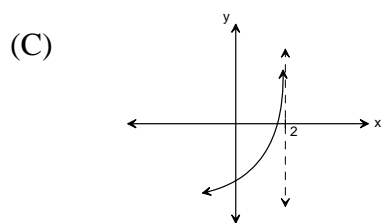
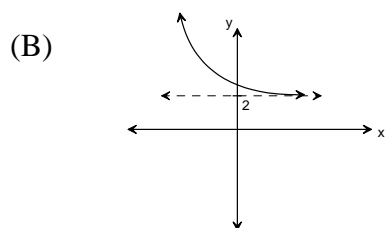
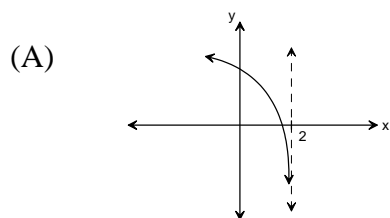
18. Suppose this diagram indicates the height of a plant (in centimeters) over several months. What is the average rate of change of the height of the plant between months 2 and 4 in cm per month?



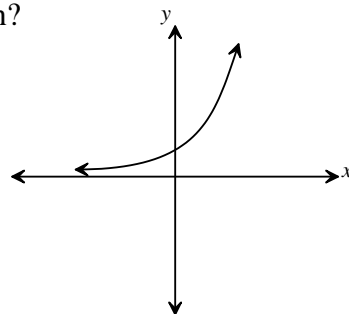
- (A)  $\frac{1}{4}$   
 (B)  $\frac{1}{2}$   
 (C) 4  
 (D) 8
19. What is the domain of  $y = \log_5(5 - x)$ ?

- (A)  $\{x \mid x > -5, x \in \mathbf{R}\}$   
 (B)  $\{x \mid x > 5, x \in \mathbf{R}\}$   
 (C)  $\{x \mid x > 5, x \in \mathbf{I}\}$   
 (D)  $\{x \mid x < 5, x \in \mathbf{R}\}$

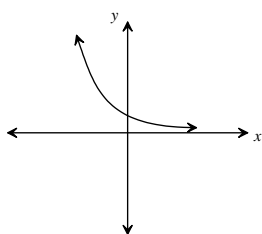
20. Which graph best represents  $y - 2 = 2^{-x}$ ?



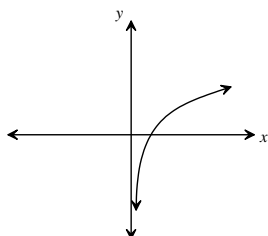
21. Which graph best represents the inverse of the function shown?



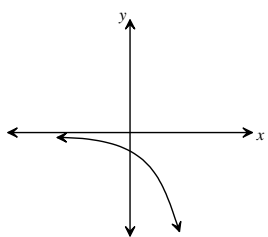
(A)



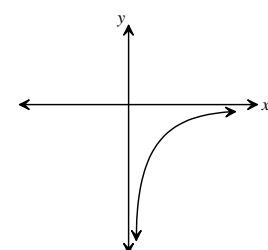
(B)



(C)



(D)



22. Which pattern below represents a geometric sequence?

(A)  $\{2 + 3, 2 + 3 + 3, 2 + 3 + 3 + 3, \dots\}$

(B)  $\{2 \times 4, 2 \times 5, 2 \times 6, \dots\}$

(C)  $\{2 \times 3, 2 \times 3^2, 2 \times 3^3, \dots\}$

(D)  $\{2 + 3, 2 + 3^2, 2 + 3^3, \dots\}$

23. The graph of  $y = 2^x$  is transformed according to the mapping rule  $(x, y) \rightarrow (x, -2y + 1)$ . Which statement best describes the graph that results?

(A) reflected in the  $x$ -axis, vertically stretched by a factor of  $\frac{1}{2}$ , and translated vertically 1 unit up

(B) reflected in the  $x$ -axis, vertically stretched by a factor of  $\frac{1}{2}$ , and translated vertically 1 unit down

(C) reflected in the  $x$ -axis, vertically stretched by a factor of 2, and translated vertically 1 unit up

(D) reflected in the  $x$ -axis, vertically stretched by a factor of 2, and translated vertically 1 unit down

24. What is the logarithmic form of  $5^x = 6$ ?

(A)  $\log_5 x = 6$

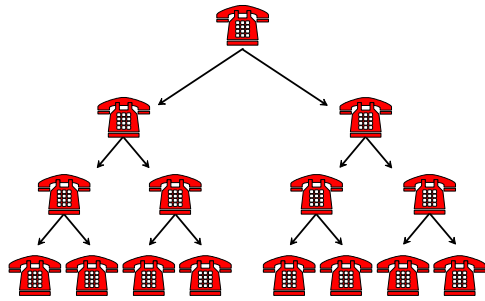
(B)  $\log_5 6 = x$

(C)  $\log_6 x = 5$

(D)  $\log_x 5 = 6$

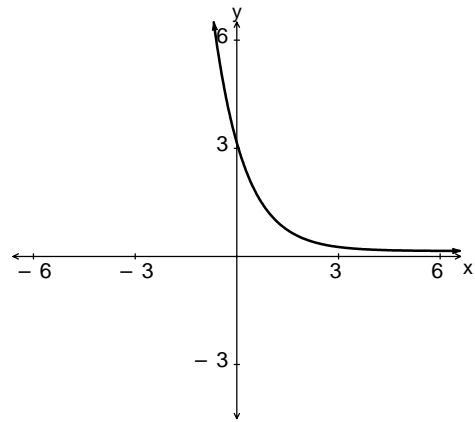
25. What type of sequence is depicted by the phone tree shown?

- (A) cubic
- (B) geometric
- (C) quadratic
- (D) quartic



26. Which equation best represents the graph shown?

- (A)  $y = -3\left(\frac{1}{3}\right)^x$
- (B)  $y = -\frac{1}{3}(3)^x$
- (C)  $y = 3(3)^x$
- (D)  $y = 3\left(\frac{1}{3}\right)^x$



27. Which expression is equivalent to  $3\left(\frac{1}{3}\right)^{2x+1}$ ?

- (A)  $1^{2x+1}$
- (B)  $3^{-2x}$
- (C)  $3^{-2x+2}$
- (D)  $9^{-2x-1}$

28. Solve:  $27^{2x-3} = \frac{1}{81}$ .

- (A)  $-\frac{1}{6}$
- (B)  $\frac{5}{6}$
- (C)  $\frac{7}{6}$
- (D)  $\frac{13}{6}$

29. Evaluate:  $\log_7 13$

- (A) 0.76
- (B) 1.19
- (C) 1.32
- (D) 1.86

30. Which situation would be best modeled by an exponential relationship?
- (A) depth of water in a cylindrical tank as it is filled with 30L of water each minute  
 (B) height of a rock thrown in the air from the time it is thrown until it hits the ground  
 (C) height of the sun above the horizon over a 24 hour period  
 (D) value of a lawnmower that depreciates by 15% annually
31. What is the focal point of the graph of the function  $-3(y + 4) = 2^x$ ?
- (A)  $(0, -4\frac{1}{3})$   
 (B)  $(0, -3\frac{2}{3})$   
 (C)  $(0, -1)$   
 (D)  $(0, 1)$
32. What is the range of the function  $-2(y + 5) = 3^{x+4}$ ?
- (A)  $\{y \mid y > -5, y \in \mathbf{R}\}$   
 (B)  $\{y \mid y < -5, y \in \mathbf{R}\}$   
 (C)  $\{y \mid y > 5, y \in \mathbf{R}\}$   
 (D)  $\{y \mid y < 5, y \in \mathbf{R}\}$
33. Solve:  $4(\log_2 x)^2 = 1$ .
- (A)  $\pm\frac{1}{2}$   
 (B)  $2^{\frac{1}{2}}$   
 (C)  $2^{\frac{1}{2}}$  and  $2^{-\frac{1}{2}}$   
 (D)  $2^2$  and  $2^{-2}$
34. Which best represents the transformation of  $y = (\frac{1}{2})^x$  using the mapping rule  $(x, y) \rightarrow (x + 1, 2y - 3)$ ?
- (A)  $\frac{1}{2}(y + 3) = (\frac{1}{2})^{x-1}$   
 (B)  $\frac{1}{2}y + 3 = (\frac{1}{2})^{x-1}$   
 (C)  $2(y - 3) = (\frac{1}{2})^{x+1}$   
 (D)  $2(y + 3) = (\frac{1}{2})^{x-1}$
35. Which expression is equivalent to  $\log_5\left(\frac{25m^3}{\sqrt{n}}\right)$ , where  $m > 0$  and  $n > 0$ ?
- (A)  $\frac{\log_5 25m^3}{\log_5 \sqrt{n}}$   
 (B)  $6\log_5 m - \frac{1}{2}\log_5 n$   
 (C)  $2 + 3\log_5 m - \frac{1}{2}\log_5 n$   
 (D)  $5 + 3\log_5 m - \frac{1}{2}\log_5 n$

36. Simplify:  $(3 - k^{-1})^2$ .

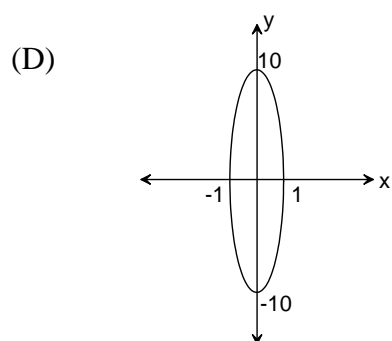
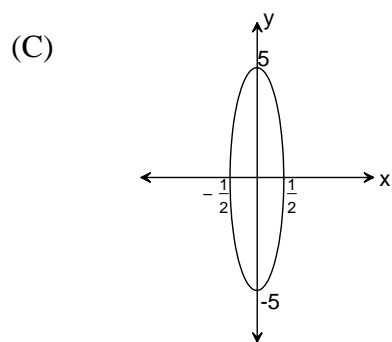
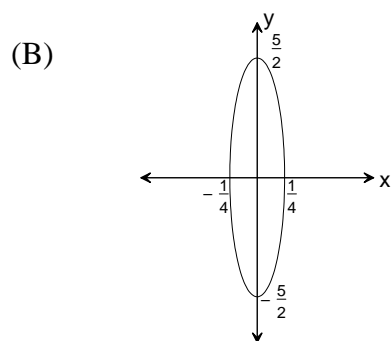
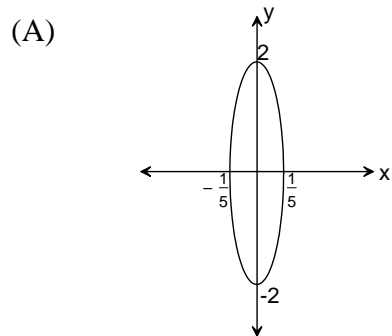
(A)  $9 - \frac{1}{k^2}$

(B)  $9 - \frac{6}{k} + \frac{1}{k^2}$

(C)  $9 + 6k + k^2$

(D)  $3 + \frac{1}{k^2}$

37. The graph of  $x^2 + y^2 = 1$  is stretched horizontally by a factor of  $\frac{1}{2}$  and stretched vertically by a factor of 5 units. Which is the resulting graph?

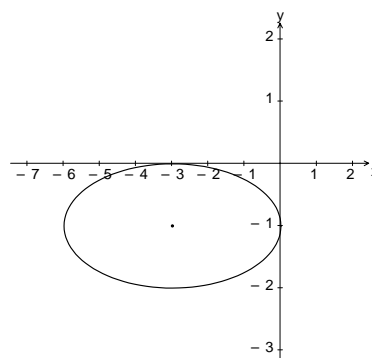


38. What is the converse of:

*“If two chords of a circle are parallel, then the two arcs between the chords are congruent” ?*

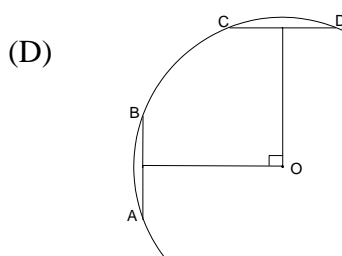
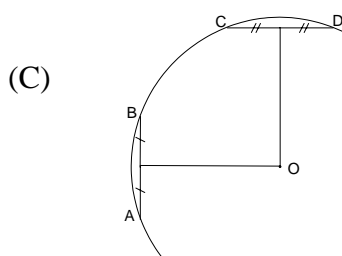
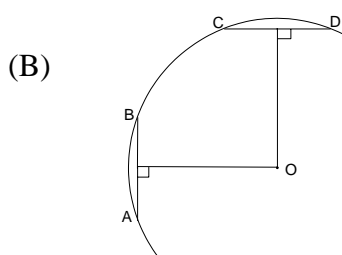
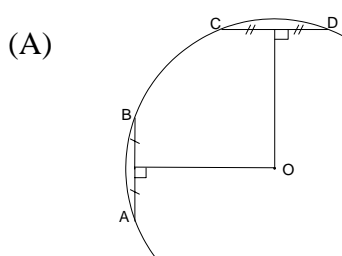
- (A) If the two arcs between the chords in a circle are congruent, then the chords are not parallel.
- (B) If the two arcs between the chords in a circle are not congruent, then the chords are not parallel.
- (C) If the two arcs between the chords in a circle are congruent, then the chords are parallel.
- (D) If two chords of a circle are not parallel, then the arcs between the chords are not congruent.

39. Which is the correct equation of the graph shown?



- (A)  $\left[\frac{1}{3}(x+3)\right]^2 + (y+1)^2 = 1$
- (B)  $\left[\frac{1}{3}(x+3)\right]^2 - (y+1)^2 = 1$
- (C)  $[(x+3)]^2 + \left[\frac{1}{3}(y+1)\right]^2 = 1$
- (D)  $[3(x+3)]^2 + (y+1)^2 = 1$

40. B and C are on  $\widehat{AD}$ . In which case must O be the center of the circle?



41. A point on the graph of  $x^2 + y^2 = 25$  is rotated through an angle  $\theta$  from standard position. What are the coordinates of the point?

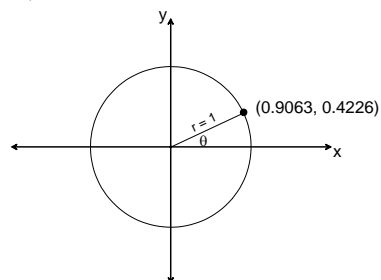
- (A)  $(5 \cos \theta, 5 \sin \theta)$
- (B)  $(5 \sin \theta, 5 \cos \theta)$
- (C)  $(10 \cos \theta, 10 \sin \theta)$
- (D)  $(\cos \theta, \sin \theta)$

42. In a circle with radius 7 cm, a chord is 3 cm from the center. How long is another chord located 3 cm from the center?

- (A)  $2\sqrt{10}$
- (B) 7
- (C)  $4\sqrt{10}$
- (D) 14

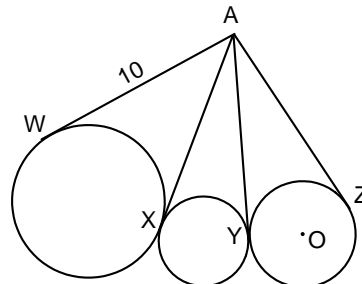
43. A circle with angle  $\theta$  in standard position is shown. What would be the coordinates of the point, with the same related angle  $\theta$  in the fourth quadrant, on a circle with radius 2?

- (A)  $(-1.8126, 0.8452)$
- (B)  $(-0.9063, 4.226)$
- (C)  $(0.9063, -0.4226)$
- (D)  $(1.8126, -0.8452)$



44.  $\overline{AW}$ ,  $\overline{AX}$ ,  $\overline{AY}$  and  $\overline{AZ}$  are tangents to the circle as shown. If  $AO = 11$ , what is the length of the diameter for the circle center O?

- (A) 1
- (B) 2
- (C)  $\sqrt{21}$
- (D)  $2\sqrt{21}$

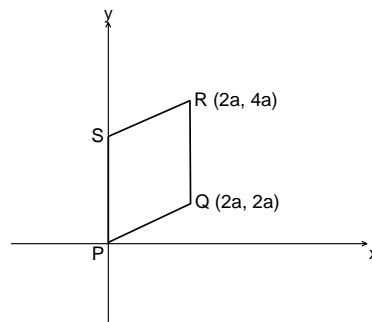


45. What is the length of the minor axis of  $\frac{1}{9}x^2 + \frac{1}{4}y^2 = 36$ ?

- (A) 12
- (B) 18
- (C) 24
- (D) 36

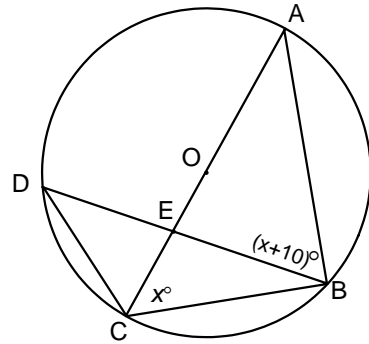
46. What is the distance between R and the midpoint of  $\overline{PQ}$ ?

- (A)  $2a^2$
- (B)  $a\sqrt{2}$
- (C)  $a\sqrt{10}$
- (D)  $10a^2$



47. In the circle with center O, what is  $m\angle BEC$  ?

- (A)  $80^\circ$
- (B)  $100^\circ$
- (C)  $(x+10)^\circ$
- (D)  $(180-x)^\circ$



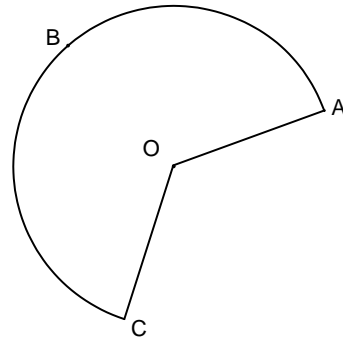
48. The graph of  $[\frac{1}{3}x]^2 + [\frac{1}{9}y]^2 = 1$  is transformed to  $[\frac{1}{3}(x-1)]^2 + [\frac{1}{3}(y+2)]^2 = 1$ . What is the mapping rule?

- (A)  $(x, y) \rightarrow (x+1, \frac{1}{3}y-2)$
- (B)  $(x, y) \rightarrow (x-1, \frac{1}{3}y+2)$
- (C)  $(x, y) \rightarrow (x+1, 3y-2)$
- (D)  $(x, y) \rightarrow (x-1, 3y+2)$

49. Sector AOC is cut from a circle and the remaining region shown is used to form a cone.

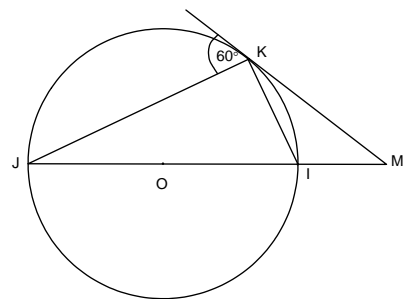
If  $m\widehat{ABC} = \frac{12\pi}{7}$  cm, what is the radius of the base of the cone in cm?

- (A)  $\frac{6}{7}$
- (B)  $\frac{24}{7}$
- (C)  $\frac{6\pi}{7}$
- (D)  $\frac{24\pi}{7}$



50. I, J, and K are on the circle,  $\overline{MK}$  is tangent to the circle and O is the center. What is  $m\angle M$  in degrees?

- (A)  $30^\circ$
- (B)  $40^\circ$
- (C)  $45^\circ$
- (D)  $60^\circ$



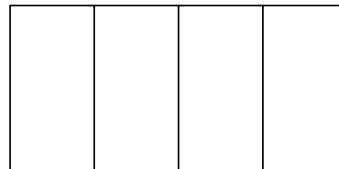
**PART II**  
**Total Value: 50%**

Answer **ALL** items in the space provided. Show **ALL** workings.

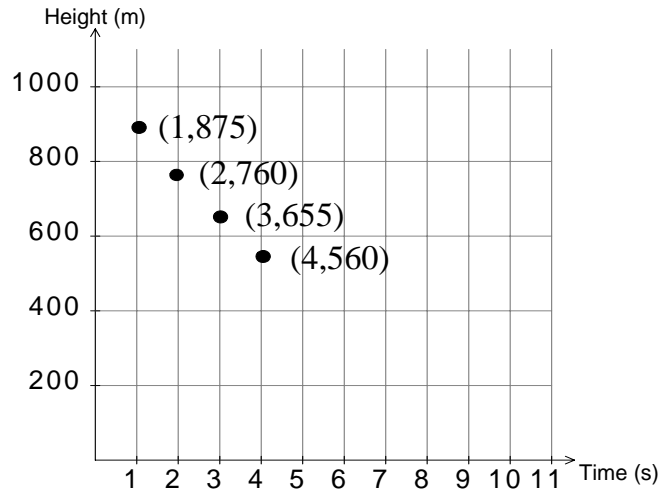
*Value*

4    51.    Algebraically determine the EXACT roots in simplest form for  $\frac{\sqrt{5-x}}{\sqrt{3x}} = \frac{\sqrt{3x}}{\sqrt{5+x}}$ .

- 4    52.    A farmer uses 400 m of fencing to create a rectangular pig pen and to divide it into four regions of equal area as shown. Algebraically determine the function which gives the area of the pig pen as a function of its width, and state the dimensions that produce maximum area.



- 4 53. A small plane begins a parabolic dive from 1000 m. The graph shows the plane's height, in metres, above the ground over time, in seconds, during a parabolic dive. Algebraically determine the quadratic function that defines the path of the plane over time and use it to determine the plane's height at 9.5 seconds.



- 3 54. (a) A diver jumps off a spring board. Her height  $h$ , in metres above the water,  $t$  seconds after she jumps, is given by  $h(t) = -4.9t^2 + 8t + 5$ . Algebraically determine the approximate instantaneous rate of change in her height at 2 seconds.

- 1 54. (b) A ball has a radius of 8 cm and the radius is decreasing at a rate of 15 mm/min. Determine the function, in terms of time, used to calculate the volume of this ball at a given instant. ( $V = \frac{4}{3}\pi r^3$ )

3    55.    Solve for  $x$ :     $\log_2(x^2 - 8) = \log_2 x + \frac{1}{2}\log_2 4$ .

4    56.    Solve for  $x$ :     $2(2)^{2x} - 5(2^x) - 12 = 0$ .

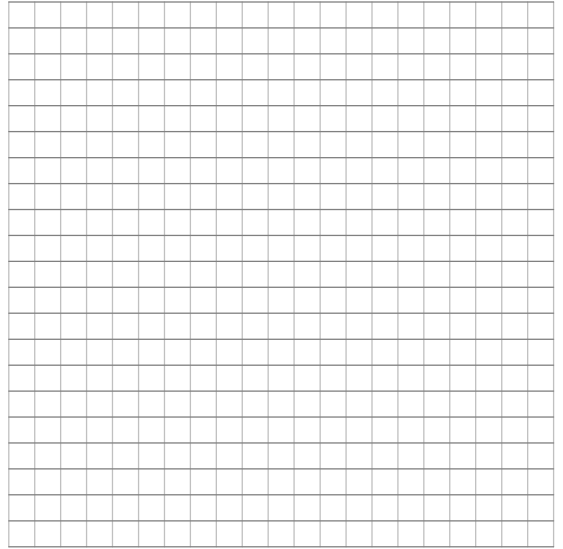
4    57.    An element has a half-life of 120 years. If its initial mass is 42 grams, algebraically determine how long it will take to decrease to 5 grams.

- 4      58.      In a stadium, temperature  $5^{\circ}\text{C}$ , the temperature of hot chocolate is recorded in the table shown. Determine the equation of the exponential function that models the temperature of the hot chocolate as it relates to time and find the temperature of the hot chocolate after 45 minutes.

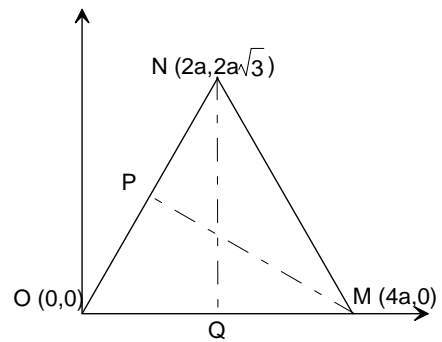
Time (mins)	0	5	10	15	20
Temp ( $^{\circ}\text{C}$ )	45	37	30.6	25.48	21.384

- 3      59.      The endpoints of a diameter of a circle are  $P(1, -3)$  and  $Q(9, 5)$ . Find the equation of the circle in standard form.

- 4 60. The center of an ellipse is  $(6, -3)$ , the major horizontal axis is 10 units long and the minor vertical axis is 6 units long. Find its equation in transformational form and sketch the graph of the ellipse.



- 4 61. Given  $\triangle MNO$  as illustrated, show that median  $\overline{MP}$  is equal in length to median  $\overline{NQ}$ .



- 4 62.  $\overline{AB}$  is a chord of a circle with radius 10 cm. If  $m\widehat{AB} = 72^\circ$ , find the area of the region enclosed by  $\overline{AB}$  and  $\widehat{AB}$ .

- 4 63. Prove that the line with equation  $x - 2y - 21 = 0$  is tangent to the circle with equation  $(x - 3)^2 + (y + 4)^2 = 20$  at the point  $(5, -8)$ .